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Remarks on taxonomy and ecology of *Leucoagaricus ionidicolor* based on a find from Central Bohemia (Czech Republic)

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Abstract — Central Bohemia (Czech Republic), a region around Prague, has varied and unique habitat conditions and a long tradition of mycological research. In 2008, rare species *Leucoagaricus ionidicolor* was found there (Křivoklátsko protected landscape area) in detritus close to the fallen trunk of *Quercus* in a thermophilous broadleaved forest. It is the first find in Bohemia (west part of the Czech Republic). A thorough description and discussion on taxonomy, ecology and distribution are given.

Key words — *Basidiomycetes*, *Agaricaceae*, thermophilous fungi, Central Europe, mycogeography

Introduction

In 2007 and 2008, the author studied threatened (red-listed) species of macrofungi (Holec & Beran 2006) in Central Bohemia, a region around Prague having varied and unique habitat conditions. The landscape encompasses a rich mosaic from lowlands to the hilly country and the submontane belt, from acidic to basic or calcareous soils, from near-natural habitats to man-made landscapes (Ložek et al. 2003, 2005). Mycologically, it is an area that has been intensely studied for almost two centuries (for summaries see e.g. Svrček 1965, 1985). Fungi of thermophilous habitats (especially dry grasslands and oak-hornbeam forests; Chytrý et al. 2001) are the most remarkable group (Svrček 1960).

In 2008, the rare species *Leucoagaricus ionidicolor* was found in this region. It is the second record for the Czech Republic (CR). The first one (Antonín & Vágner 1997) originates from south Moravia (eastern part of the CR). As thorough descriptions of this species are few (Bellù & Lanzoni 1988, Candusso & Lanzoni 1990, Contu & Serra 1998, Vellinga 2001, Hausknecht & Pidlich-Aigner 2004, Derboven 2008), the Bohemian material is described here in detail and the taxonomy, ecology and distribution of *L. ionidicolor* is discussed.

Material and methods

Field work was carried out during 2007–2008. The search was focused on protected areas in Central Bohemia, both the large-scale ones (PLA: protected landscape areas Křivoklátsko, Kokořínsko, Český Kras) and the small-scale ones (nature reserves). *Leucoagaricus ionidicolor* was found only at one locality in 2008. The microscopic examinations were made using an Olympus BH-2 microscope on material mounted in a 5% KOH solution. The iodine reaction was studied in Melzer's reagent prepared according to the formula given in Moser (1983). For spore size measurements, randomly selected mature spores were used. Illustrations of microcharacters were drawn at a magnification of 500 × and 1250 × using a drawing tube. For micromorphological terminology see Bas et al. (1988). The voucher specimen is deposited in the herbarium PRM (National Museum, Mycological Department, Prague).

Abbreviations: CR: Czech Republic; L: total number of lamellae reaching the stipe.

Results

Leucoagaricus ionidicolor Bellù & Lanzoni, Rivista di Micologia 31(3–4): 107, 1988. FIGURE 1

= *Leucocoprinus caeruleoviolaceus* D.A. Reid, Mycol. Res. 93: 413, 1989.

≡ *Leucoagaricus caeruleoviolaceus* (D.A. Reid) Bon, Doc. Mycol. 23(91): 33, 1993.

≡ *Leucoagaricus ionidicolor* var. *caeruleoviolaceus* (D.A. Reid) D.A. Reid, Mycotaxon 53: 327, 1995.

SELECTED PHOTOGRAPHS: Bellù & Lanzoni (1988), Henrici (2000), Derboven (2008).

MACROCHARACTERS (the description is based on one mature fruitbody missing the lower part of stipe) — PILEUS 3 cm broad, plano-concave, dry, not hygrophanous; surface completely brown-violet and granular at the very centre, towards the margin disrupted into fine, densely arranged, raised, fibrillose-tomentose, pale violet scales lying on whitish background; LAMELLAE crowded, L = ca. 60–70, ventricose, adnexed to almost free, purely white, with concolorous, finely eroded edge; STIPE (only upper part present, the lower part with the annulus was eaten off by animals) cylindrical, 0.3 cm broad; surface whitish to yellowish with pink tinge at apex, stipe covering finely fibrillose-granular, white; stipe context white, with cottony consistency; SMELL none; no part of the fruitbody changed colour when bruised.

MICROCHARACTERS — BASIDIOSPORES (5.2–)5.5–6.0(–6.5) × 3.2–3.5(–4.0) µm (20 spores measured), ellipsoid to ellipsoid-ovoid; hilar appendix small but distinct; germ pore absent; wall rather thick, c. 0.5 µm, smooth; spores distinctly dextrinoid in Melzer's reagent: pale vinaceous brown (D3 according to Vesterholt 2005: 18), each spore with one droplet inside (in 5 % KOH); BASIDIA 18–20 × 6–7 µm, rather short, clavate to narrowly clavate, 4-spored,

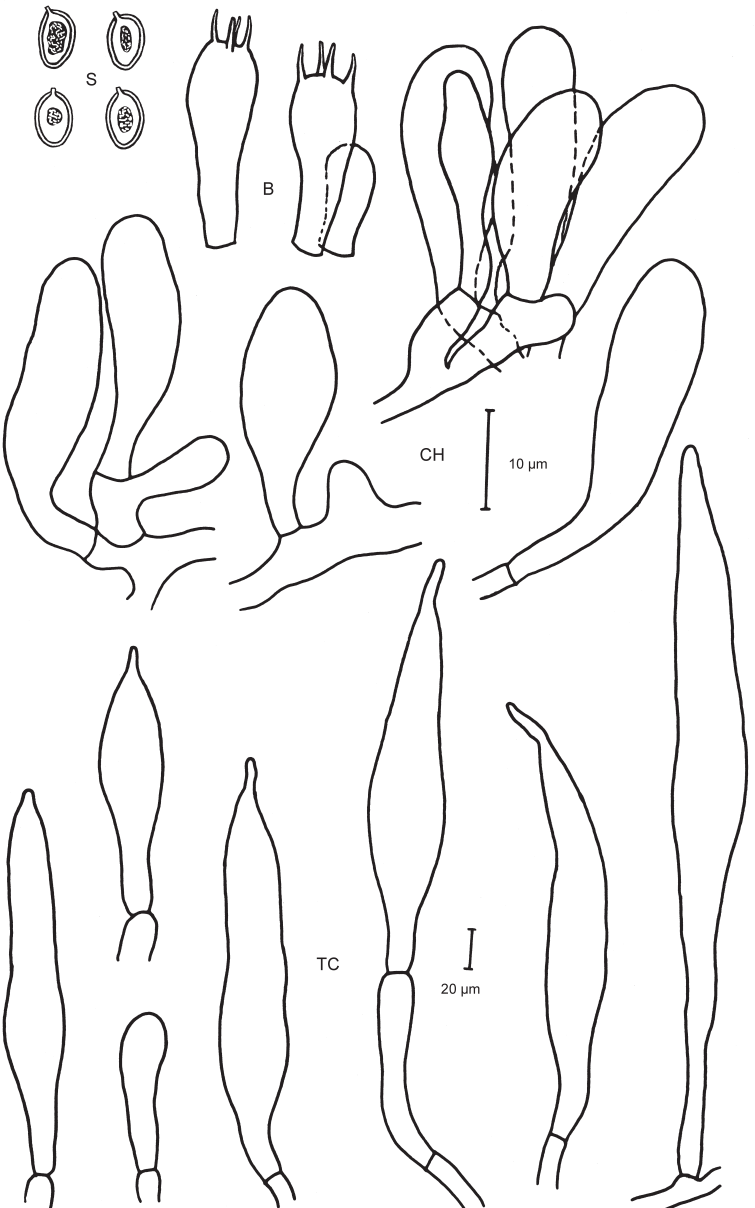

Figure 1. *Leucoagaricus ionidicolor* (PRM 915219).
B: basidia and basidiole (right), CH: cheilocystidia, S: basidiospores,
TC: terminal cells of the pileipellis hyphae.

hyaline; BASIDIOLES small, 13–15 × 5–6 µm, clavate, hyaline; LAMELLA EDGE sterile, composed of cheilocystidia arranged in tufts which are intermixed with narrow sites of parallel hyphae without cystidia; CHEILOCYSTIDIA 20–30 × 6–10 µm, clavate to narrowly clavate, with straight to curved basal part, hyaline, thin-walled, growing both at the end of their basal cell or laterally; PLEUROCYSTIDIA absent; LAMELLAR TRAMA almost irregular, not dextrinoid, of interwoven hyphae; cells 8–20 µm broad, hyaline, cylindrical to slightly inflated, some of them rather short (up to 30 µm); almost globose or strongly inflated cells rarely present; SUBHYMENIUM made up of densely arranged, short to isodiametric cells; PILEUS COVERING a trichoderm of uplifted septate hyphae with yellow-brown wall and finely granular yellow-brown content having violet tinge (observed in water); cells cylindrical, 5–7 µm broad; terminal cells narrowly clavate when young, then very long, 80–200 × 15–20 µm, narrowly fusiform with rostrate apex; STIPE COVERING not studied as the stipe is almost completely absent (see above); CLAMP CONNECTIONS absent in all tissues.

MATERIAL STUDIED — **CZECH REPUBLIC. Central Bohemia:** W of Prague, Křivoklátsko protected landscape area, 3 km SE of Křivoklát castle near Rakovník town, STŘÍBRNÝ LUH NATURE RESERVE: E PART – GORGE CALLED ČERTŮV LUH (UPPER PART), near-natural mixed thermophilous forest (*Fagus*, *Acer*, *Carpinus*, *Fraxinus*, *Quercus*), alt. 330 m, in detritus close to fallen trunk of *Quercus*, 27. VIII. 2008 leg. and det. J. Holec (PRM 915219).

Discussion

Taxonomy

Almost all characters of my material agree well with the original description by Bellù & Lanzoni (1988) and photographs by Henrici (2000) and Derboven (2008). A small discrepancy concerns the width of terminal cells in the pileus covering which is smaller in material observed by Bellù & Lanzoni (1988: 11–16 µm) and Vellinga (2001: 8–12 µm). Vellinga (2001) used the width as one of the distinguishing characters against *L. marriagei* (D.A. Reid) Bon (having the width of 10–17 µm according to her; see also Reid 1966). However, my and Bellù & Lanzoni's data show that there is an overlap and the length of the terminal cells is a more distinctive character (longer in *L. ionidicolor*, shorter in *L. marriagei*). It agrees e.g. with data by Antonín & Vágner (1997), who observed terminal elements measuring 30–250 × 6–20 µm in *L. ionidicolor*.

The spore size observed in the original material from Spain (Bellù & Lanzoni 1988) and my collection from Bohemia (this paper) is rather small, maximally reaching 6.5 × 4 µm. In other records (e.g. Antonín & Vágner 1997, Vellinga 2001, Knudsen & Vesterholt 2008) the spores are somewhat larger. *Leucoagaricus ionidicolor* apparently has a broader range of spore size [about (5.0)5.5–7(7.5) × (3.0)3.2–4.5(5.0) µm; for references see above], with spores reaching up to 7.8 µm in length observed by Hausknecht & Pidlich-Aigner

(2004). It is interesting that one later collection from the type locality (Vila et al. 1997) had ellipsoid-amygdaliform spores reaching up to 9 µm long.

I agree with Vellinga (2001) that the two varieties distinguished by Reid (1995: *L. ionidicolor* var. *ionidicolor* and var. *caeruleoviolaceus*) represent in fact one variable species. It is supported by the overlap of characters given by Reid (1995) himself and by the overlap in characters discussed above.

It is somewhat questionable whether *Leucoagaricus ionidicolor* var. *major* J. Charb. et al. (Bon & Charbonnel 2000) really belongs to *L. ionidicolor*. The fruitbodies representing the variety are very robust [pileus up to 10–12 cm, stipe 10(–12) × 0.8(–1) cm] and the terminal elements of the pileus covering are relatively short (up to 100–150 µm). The description of microcharacters is too brief and the structures are not illustrated. Albert (2008) also presents larger and robust fruitbodies (pileus 4–8 cm, stipe 4–8 × 0.5–1 cm), also much more pink coloured than *L. ionidicolor;* unfortunately, the cells of pileus covering are not described. In my opinion, a detailed revision of these collections is necessary; unfortunately my requests for material on loan have been unsuccessful.

There are several species with a similar appearance. Briefly, *L. marriagei* (which Vellinga (2006) considers identical with the earlier described *Lepiota roseolivida* Murrill, suggesting that *L. marriagei* is a synonym) differs by slightly larger and amygdaliform spores, shorter (up to 160 µm) terminal elements, and smaller delicate fruitbodies (Reid 1995, Vellinga 2001). *Leucoagaricus ianthinophaeus* Locq. differs by exannulate stipe and pileus covering with tufts of short cylindrical elements intermixed with inflated to sphaerical cells (Locquin 1952, Reid 1995). *Leucoagaricus ianthinosquamulosus* Guinb. has longer spores, 2-spored basidia, and encrusting pigment in the pileus covering (Vellinga 2001). *Leucoagaricus jubilaei* (Joss.) Bon is very similar both macro- and microscopically (see e.g. Gennari 2007); however, it differs because of the colour changes when bruised (from yellow, rusty-orange to red).

Ecology

The Bohemian find published here is from a broadleaved forest where the fruitbodies occurred in detritus close to a fallen trunk of *Quercus*. *Leucoagaricus ionidicolor* was first found in the CR by Antonín & Vágner (1997) growing under *Quercus* and *Fraxinus* in the Ranšpurk riverine (riparian) virgin forest in SE Moravia. Occurrence in riverine forests are also cited by Vasas (2000) from Hungary (forest composed of *Quercus, Fraxinus* and *Ulmus*) and Hausknecht & Pidlich-Aigner (2004) from Austria. In Great Britain, the species was collected in rich soil and debris from a decayed *Carpinus* log or under fallen trunk of *Carpinus* (Henrici 2000, Legon & Henrici 2005), in southernmost Sweden on soil or strongly decomposed wood in deciduous forests (Knudsen & Vesterholt 2008), and in Austria also in a mixed forest under *Robinia* (Hausknecht &

Pidlich-Aigner 2004). On the other hand, the species was found under conifers in Spain (Bellù & Lanzoni 1988, Vila et al. 1997; under exotic trees: *Sequoia, Cedrus, Pinus*), Sardinia (Italy; Contu & Serra 1998: near *Juniperus phoenicea*), Austria (Aron et al. 2005: on litter in a coniferous forest), Great Britain (Reid 1989: under *Pinus*, as *Leucocoprinus caeruleoviolaceus*) and The Netherlands (Vellinga 2001: under *Clematis vitalba* growing around *Picea*). These data suggest that *L. ionidicolor* is able to grow both in coniferous and broadleaved forests and to decay both raw humus (litter and debris) and soft wood in final stages of decay. It occurs in natural forests as well as man-influenced and man-made habitats (parks, ruderal sites).

Distribution

To date, *Leucoagaricus ionidicolor* is known from Italy (e.g. Candusso & Lanzoni 1990, Contu & Serra 1998), Spain (e.g. Bellù & Lanzoni 1988, Rovira & Ballarà 2006), The Netherlands (Vellinga 2001), Belgium (Derboven 2008), Great Britain (Reid 1989: as *Leucocoprinus caeruleoviolaceus,* Henrici 2000, Legon & Henrici 2005), southernmost Sweden (Skåne: Lange 2005, Knudsen & Vesterholt 2008), France (e.g. Bon 1993), Czech Republic (Antonín & Vágner 1997, this paper), Austria (Pidlich-Aigner 2003, Hausknecht & Pidlich-Aigner 2004, Aron et al. 2005), and Hungary (Vasas 2000). However, the species is rare everywhere and in most countries it is known from only 1–5 localities.

Both finds in the CR originate from the warmest areas of the country. The same fact concerns most localities outside the Mediterranean. For example, in the Netherlands the calcareous hilly area is warmer than the rest of the country (pers. comm. E.C. Vellinga) and southernmost Sweden is also a relatively warm area. Generally, the species clearly prefers warmer areas of Europe (the Mediterranean, Atlantic areas of west Europe, southernmost parts of Scandinavia, warmer areas of central Europe).

There are no older collections of *L. ionidicolor* in the Czech Republic (the material in the richest herbaria PRM and BRNM was checked). As such a beautifully coloured species would certainly not escape attention of older mycologists, it is possible that these recent records may be attributable to climatic changes (e.g., the relatively warmer summers and milder winters) of the last 15 years.

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